THURSDAY, MARCH 21, 1895.

MODERN BACTERIOLOGY.

Lehrbuch der Bakteriologischen Untersuchung und Diagnostik. By Dr. Ludwig Heim. Crown 8vo. Pp. 528. (Stuttgart: Verlag von Ferdinand Enke, 1894.)

THE writer of this volume takes care to leave us in no doubt as to its purpose. We are told in the preface, "Für den Praktiker ist dieses Buch geschrieben." Again, "Ein Lehrer und ein Führer soll dies Buch sein." Even the unfortunate student, who, in spite of attending a practical course on bacteriology, has failed to carry away an adequate knowledge of his subject, is to turn to this book for consolation, where "he may yet arrive by its assistance at his goal, providing he follow step by step and point by point the instructions which it contains."

But after a careful perusal of this bulky octavo volume, we find ourselves unable to agree with the author's estimate of his book. It contains a mass of facts, a bewildering maze of detail through which we think no student would have the patience to thread his way, much less the student who has failed in spite of passing through a course of practical instruction. Possibly Dr. Heim knows too much, or is too generous in giving his knowledge away. A little more reticence would have not only made his book less unwieldy in dimensions, but the whole treatment of the subject would have gained in simplicity.

The excessive love of minute detail is characteristic of most German text-books, but we do not think the following example of it will easily be surpassed: "Smokers must put their cigars or cigar-ends so down that the burning part rests on the table, the mouth-piece remaining free. Eating must not under any circumstances be carried on in the laboratory. The moistening of the fingers in the mouth is to be rigidly avoided. Gum labels must only be wetted with water." We can only say that if the student approaches his subject with as little feeling for it as the necessity of these instructions implies, he will, we predict, never do much, however often he may read through Dr. Heim's volume!

The work is divided into three parts—bacteriological manipulations, including microscopic investigations; the preparation of culture media, and experiments on animals. The latter section is given in greater detail than in most text-books, and is very clearly described. Secondly, the morphological and other characteristics of bacteria, containing an admirable though brief account of the subject of immunity and the latest developments of serum therapeutics. Thirdly, the diagnosis of bacteria in disease, as well as their demonstration in our surroundings. The information imparted is, in nearly all cases, gathered from the most recent publications in Germany; but on consulting the list of journals referred to in the text, the only foreign publication considered worthy of notice is the *Annales de l'Institut Pasteur*, English periodicals being completely ignored, as well as the excellent *Annali dell' Istituto d'Igiene Sperimentale*, published in Rome, and the official reports, published in St. Petersburg, of the work carried out in the Imperial Institute of Experimental Medicine.

This accounts for the omission of all reference to Palermo's most interesting experiments on the attenuation of the pathogenic properties of the cholera bacillus through exposure to sunshine. In the section describing the methods which may be adopted for reducing and increasing the virulence of particular bacteria, mention is made of Arloing's isolated investigation on the attenuation of the disease-producing powers of the anthrax bacillus through three hours' insolation; but the fact is passed over, that Palermo succeeded in reducing cholera bacilli to the condition of vaccine through the action of sunshine, so that guinea-pigs, when inoculated first with *insolated* cholera bacilli, and then with ordinary virulent cholera bacilli, instead of dying, as usual, in about eighteen hours, remained alive.

The survey of the present state of our knowledge on the question of immunity is, perhaps, the most interesting and best-written portion of the book. Theoretical considerations of the subject are kept in abeyance, and prominence is only given to the practical outcome of the investigations which have been made. The results of Roux's application of serum in the treatment of diphtheria in the Paris hospitals appeared too recently to admit of incorporation here. In the section on the production of spores, the author throws doubt on Roux's method for obtaining anthrax bacilli permanently deprived of their power of producing spores, so-called *asporogene* anthrax. He states that he has not been able to succeed in procuring such a race of anthrax bacilli, although he has made numerous attempts with the utmost regard to Roux's recipe. The method devised by Phisalix is preferred, which consists in prolonged exposure of anthrax cultures to a temperature of from 30° to 42° C.; but this device only answers as long as the bacilli are kept in ordinary culture media, for even when introduced into broth containing a fraction of guinea-pig's blood, they are at once sufficiently revived to produce spores.

In describing the capacity for multiplication possessed by bacteria, an interesting experiment is cited, which we do not remember having seen elsewhere, showing that 149 cholera bacilli kept at 37° C. had within three hours increased to as many as 96,000, and that the minimum time occupied by these bacilli in the production of a new generation was twenty minutes. This involves, however, the assumption that in the process of multiplication from every individual cell two new ones are started, never more or less.

The concluding portion of the volume, which deals with bacteriological diagnosis, and occupies close upon 200 pages, is helpfully illustrated by photographic plates of many pathogenic micro-organisms. In this section, in speaking of the vexed question of the microbic origin of scarlet fever, Dr. Heim considers that the cause of this disease has not yet been discovered, and that the streptococci which have been found by various observers must be regarded as a secondary and not primary infection; in his own words, "man muss sich wohl hüten dabei die Grundkrankheit zu übersehen." According to Doehle, scarlet fever may be with more likelihood ascribed to protozoa; and this authority is of opinion

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that similar organisms may very possibly be found to be the exciting cause of both measles and small-pox. In malaria protozoa are now accepted as the origin of the disease, and a similar suggestion has been made to account for yellow fever in the absence of all trustworthy microbic evidence. The examination of air, water, &c., for micro-organisms, is, of course, only dealt with in a very cursory manner. In the small section devoted to water-bacteriology, we are glad to find Dr. Heim calling attention to the errors which may so easily occur in the correct numerical estimation of bacteria in water.

Dr. Heim has spent an immense amount of patient labour on the compilation of this volume, and he approaches his subject invariably from the point of view of a man who has worked out things and problems for himself; it is thus that his book acquires an original flavour, which, whilst making it more palatable to the teacher, renders it less likely to find favour, or prove useful to the student. We venture to think that it will, in the concluding words of the preface, "sich den Herrn Kollegen nützlich erweisen"; and it must in any case be regarded as a responsible and noteworthy contribution to the bacteriological text-books, now fairly numerous, already in existence.

G. C. FRANKLAND.

CHEMICAL ANALYSIS.

Die wissenschaftlichen Grundlagen der analytischen Chemie. Von W. Ostwald. (Leipzig: Wilhelm Engelmann, 1894.)

THE Professor of Chemistry in the University of Leipzig has taken so assiduously to the making of books that, as regards the fruitfulness of his pen, he may well take rank with even the more prolific of our writers of fiction. Despite this fact, it is not too much to say that none of his productions will appeal to a larger section of the chemical public than the little volume under notice. For although it is professedly a work on general analytical chemistry, it will mainly make its mark as a concise exposition of qualitative analysis, based upon the most recent developments of chemical theory.

The author first deals with the modes of recognising substances—*Zustands-* and *Vorgangseigenschaften*—and the modes of separating substances prior to recognition. Amongst other things the theory of filtration and washing is discussed, together with the complication introduced by "adsorption"—that curious property in virtue of which the concentration of a solution near the surface of an immersed solid is greater than the average concentration. Separation, it is emphasised, must always be mechanical, and if it cannot be effected directly by the physical methods described, such as distillation or the action of solvents, chemical operations, such as form the subject-matter of qualitative analysis, have first to be performed.

At this point we meet with views which are novel in an analytical text-book. The theory of analysis, it is urged, is now upon a new platform. With van't Hoff and Arrhenius, we must regard the properties of dilute solutions of acids, bases, and salts as mainly those of their ions; and herein lies a simplification of the utmost importance, for it is possible to express in terms of the properties of, say, 50 anions and 50 cathions the properties of the 2500 odd salts to which they may give rise. A digest of the new theory of the constitution of solutions is here given, and of the mode in which the law of mass action may be extended to analytical reactions by regarding the ions as individual substances.

A precipitate in its mother-liquor we are to regard as a system in equilibrium. Precipitation is never complete. On precipitating $BaSO_4$, for example, a small amount remains in solution, and portion of this is dissociated into the ions Ba and SO_4. The precipitate is in equilibrium with the soluble $BaSO_4$, while it in turn is in equilibrium with the ions. Now the active mass of a solid is constant, hence for equilibrium the product of the concentrations of the ions in the solution must have a definite value—the solubility product. If the product be raised above this definite value, more precipitate must form; if it be lowered, more precipitate must dissolve. We have here a reason for the common practice of adding an excess of precipitant in order to ensure complete precipitation. In the case quoted the solubility product of the $BaSO_4$ will be partly kept up to the necessary value by means of the Ba ions of the excess of precipitant, and hence less $BaSO_4$ will require to remain in solution. This is a particular instance of the general rule that the solubility of a substance is diminished by the presence of another having an ion in common with it.

We can thus formulate a theory of precipitation. It is in general the result of interaction between ions; consequently, if on mixing two solutions ions are present which can form a substance having a sufficiently small solubility product, that substance is precipitated, and causes which affect the solubility product are the causes affecting the precipitation. Here are one or two instances of this method of treating analytical reactions.

The solubility of $Mg(HO)_2$ in water is regulated by the solubility product of Mg and HO ions. If hydrochloric acid, which is almost completely dissociated, be added to the water, the H ions of the acid at once unite with the HO ions of the dissolved $Mg(HO)_2$ to form water, because water is practically undissociated. In this way the solubility product of the $Mg(HO)_2$ is diminished, and more solid $Mg(HO)_2$ must dissolve in order to maintain the product at the value necessary for equilibrium. If sufficient HCl be present, all the $Mg(HO)_2$ will pass into solution.

The following case of precipitation is more complex:—If CO_2 be passed through a solution of $Pb(NO_3)_2$, little or no precipitate is obtained, whereas two-thirds of the lead is thus removed from a solution of $Pb(C_2H_3O_2)_2$. In solution carbonic acid is but slightly dissociated into its ions 2H and CO_3; yet if $Pb(NO_3)_2$ be present, the product of the concentrations of the Pb and CO_3 ions is greater than the solubility product of $PbCO_3$; hence a precipitate forms. At the same time, however, HNO_3 is produced, and H and NO_3 ions accumulate in the solutions, since HNO_3 is strongly dissociated. Now H ions diminish the electrolytic dissociation of the H_2CO_3 just as excess of NH_3 or HCl diminishes the ordinary dissociation of NH_4Cl. The solubility product of the CO and Pb ions is thus diminished, and but a small quantity

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